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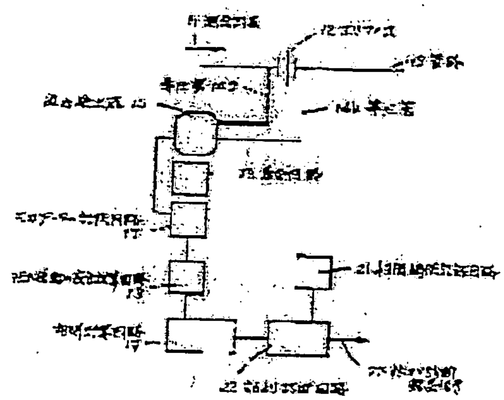
(54) APPARATUS FOR DETECTING CLOG OF CONDUIT

(57)Abstract:

PURPOSE: To detect the clogging of a pressure introduction pipe by an apparatus easy to maintain and improve the pressure-measuring reliability, by detecting a clogging state of one or both of the pressure introduction pipes from the correlation of oscillations of a differential signal and a static pressure signal.

CONSTITUTION: A differential pressure value of an object 11 to be measured which is transmitted by pressure introduction pipes 14a, 14b and a static pressure value (pressure PH at the high pressure side) are detected by a differential pressure detector 15, and a pressure value PL at the low pressure side is calculated from the detected pressure value by a differential circuit 16. The differential pressure value, static pressure value and pressure value PL are stored in 17. At the same time, the oscillation degree of each pressure is calculated at 18. Thereafter, the correlation of oscillation degrees of the pressures is calculated in a prescribed method at a correlation-calculating circuit 19 and output to a clog-diagnosing circuit 22. The circuit 22 compares values of the correlation in each mode of the pressure introduction pipes 14a, 14b held in a correlation- recording circuit 21 beforehand and the correlation output from the circuit 19, thereby to calculate how the pressure introduction pipes 14a, 14b clog and output a clog diagnosis result signal 23.



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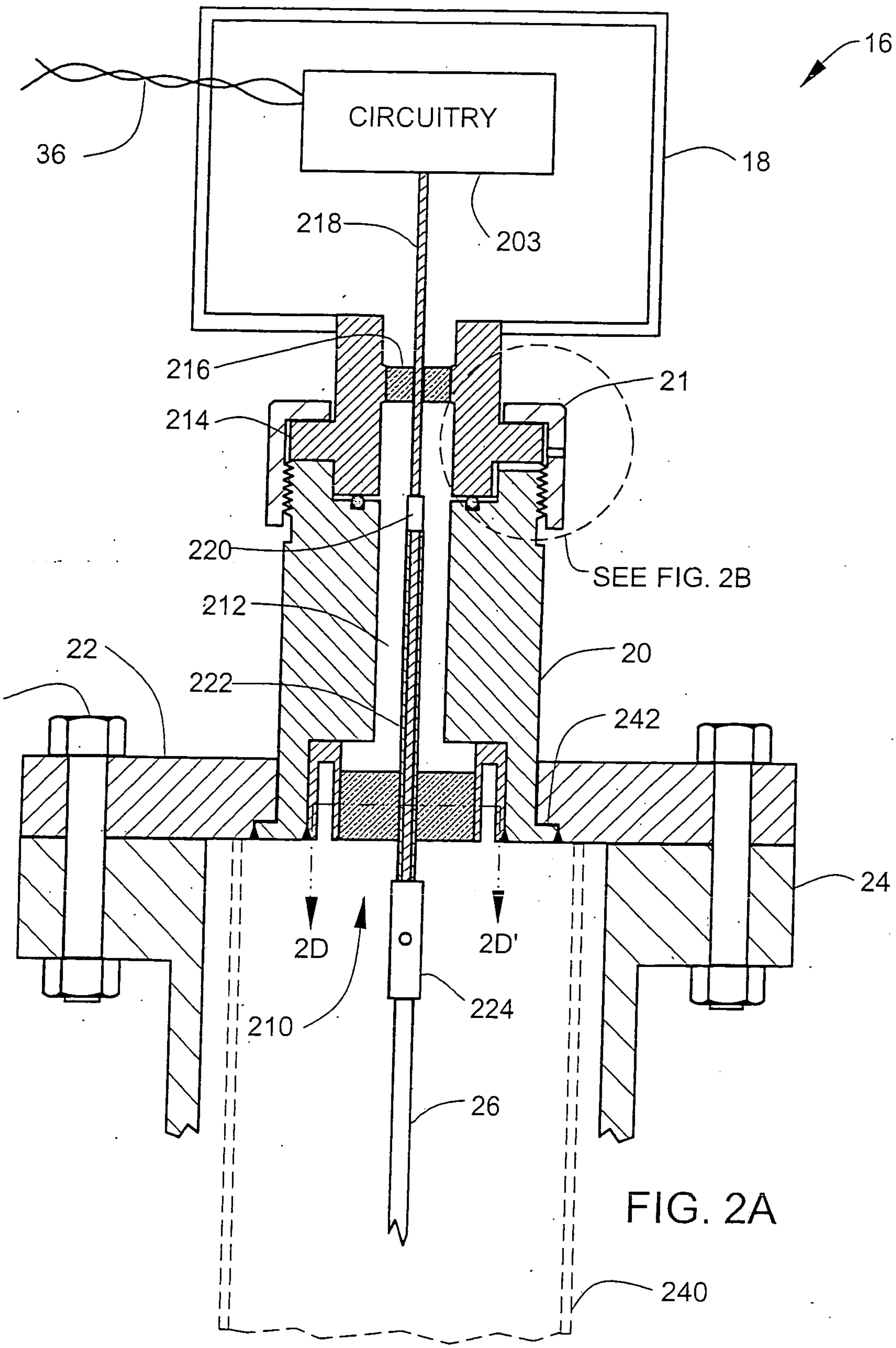
16
CIRCUITRY
36
18
218
203
216
21
214
220
SEE FIG. 2B
212
22
20
23
222
242
24
2D
2D'
224
210
26
240

FIG. 2A

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] Duct lock-out detection equipment characterized by to provide the detection means which detects the plugging condition of one side of said connecting pipe, or both from the correlation of the splash of said differential pressure signal, and a splash of said static pressure signal, and emits a detection signal in the duct lock out detection equipment possessing a differential pressure detection means to detect differential pressure and a static pressure through two connecting pipes and this connecting pipe.
[Claim 2] A differential pressure value is added from the splash width of face of a static pressure value and the static pressure value at the time of making into a static pressure the splash width of face of the low-tension side pressure value which deducts a differential pressure value and is acquired from the splash width of face of a static pressure value and the static pressure value at the time of making the splash width of face of a differential pressure value, and a high-tension-side pressure value into a static pressure or the splash width of face of a differential pressure value, and a low-tension side pressure value. Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the correlation of the splash width of face of the high-tension-side pressure value acquired, and emits a detection signal.
[Claim 3] Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the difference of the degree of a splash of a high-tension-side pressure value, and the degree

of a splash of a low-tension side pressure value, the degree of a splash of a high-tension-side pressure value and the difference of the degree of a splash of differential pressure, and the difference of the degree of a splash of a low-tension side pressure value, and the degree of a splash of differential pressure, and emits a detection signal.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Detection of plugging of a connecting pipe is possible for this invention, it can improve the dependability of a pressure survey, and a maintenance is related with easy duct lock out detection equipment.
[0002]
[Description of the Prior Art] Drawing 12 is the configuration explanatory view of the conventional example currently generally used conventionally, for example, is a "industrial-instrumentation handbook" (volume on pneumatic instrument). Volume on YOKOGAWA ELECTRIC factory Tokyo Denki University Press issuance December 10, Showa 41 issuance The 2nd page It is shown in drawing 13 .
[0003] In drawing 12 , 1 is a duct where the measurement fluid 2 flows. The valve by which 3 controls the measurement fluid flow, and 4 are positioners which control whenever [valve-opening / of a valve 3]. 5 is a controller which controls a positioner 4. 6 detects the measurement fluid flow controlled by the valve 3, it is the body of a flowmeter which sends a detecting signal to a controller 5, and the differential pressure transmitter is used in this case. 7 is a connecting pipe which transmits the pressure of the measurement fluid 2 to the body 6 of a flowmeter. 8 is an orifice.
[0004] In the above configuration, if the measurement fluid 2 flows to a duct 1, the body 6 of a flowmeter will measure the flow rate of the measurement fluid 2. The hydrometry signal of the body 6 of a flowmeter is sent to a controller 5, it is compared with desired value, a control signal is sent to a valve positioner 4, and closing motion of a valve 3 is performed.
[0005]
[Problem(s) to be Solved by the Invention] However, in such equipment, although abnormalities can be detected when large fluctuation of a flow rate to the extent that the output of the body 6 of a flowmeter can be shaken off arose, or when plugging arises in a connecting pipe 7, abnormalities are in a connecting pipe 7, and a periodic check etc. is checked, in many cases, it is difficult malfunction detection. In order to prevent these abnormalities before an output abnormal occurrence, it cannot but predict experientially from change of an output, or must be got blocked with an operator's periodic check

etc., and a condition must be discovered. From an insurance side, a frequent periodic check is required, and frequent inspection has the problem of taking time amount and time and effort. Furthermore, there was a problem that it could not respond in sudden plugging. This invention is made in order to solve the problem of the above-mentioned conventional technique. The object of this invention aims at offering the duct lock out detection equipment which can emit an alarm, when the plugging condition of a connecting pipe is always supervised and plugging of a connecting pipe exceeds predetermined level. That is, detection of plugging of a connecting pipe is possible, the dependability of a pressure survey can be improved, and offering easy duct lock out detection equipment has a maintenance.
[0006]
[Means for Solving the Problem] It is duct lock-out detection equipment characterized by to provide the detection means which this invention detects the plugging condition of one side of said connecting pipe, or both from the correlation of the splash of said differential-pressure signal, and a splash of said static pressure signal in the duct lock-out detection equipment possessing a differential-pressure detection means detect differential pressure and a static pressure through (1) 2 a connecting pipe and this connecting pipe in order to attain this object, and emits a detection signal.
(2) Add a differential pressure value from the splash width of face of a static pressure value and the static pressure value at the time of making into a static pressure the splash width of face of the low-tension side pressure value which deducts a differential pressure value and is acquired from the splash width of face of a static pressure value and the static pressure value at the time of making the splash width of face of a differential pressure value, and a high-tension-side pressure value into a static pressure or the splash width of face of a differential pressure value, and a low-tension side pressure value. Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the correlation of the splash width of face of the high-tension-side pressure value acquired, and emits a detection signal.
(3) Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the difference of the degree of a splash of a high-tension-side pressure value, and the degree of a splash of a low-tension side pressure value, the degree of a splash of a high-tension-side pressure value and the difference of the degree of a

splash of differential pressure, and the difference of the degree of a splash of a low-tension side pressure value, and the degree of a splash of differential pressure, and emits a detection signal. It constitutes.

[0007]

[Function] In the above configuration, differential pressure and a static pressure are detected through a connecting pipe in a differential pressure detection means. In a detection means, from the correlation of the splash of a differential pressure signal and the splash of a static pressure signal which were detected with the differential pressure detection means, the plugging condition of one side of a connecting pipe or both is detected, and a detection signal is emitted. Hereafter, it explains to a detail based on an example.

[0008]

[Example] Drawing 1 is the block diagram of one example of this invention. In drawing, 11 is the measuring object, for example, has the pressure fluctuation of **300mmHg extent focusing on 10 kgf/cm2. 12 is the orifice prepared in the duct 13. 14a and 14b are connecting pipes with a bore of about 15mm in this case for transmitting a pressure from the measuring object 1. 15 is the differential pressure detector connected to the end of a connecting pipe 14, and detects a static pressure value and a differential pressure value. Since the high-tension-side pressure PH is made into the static pressure according to the convention of JIS, a high-tension-side pressure is considered to be a static pressure as a static pressure also here.

[0009] 16 is the difference circuit where the output of a pressure sensor 3 is inputted, and is a difference circuit which deducts differential pressure from a static pressure value, and carries out low-tension side pressure value PL count. The low-tension side pressure value PL is the pressure ****(ed) by connecting pipe 14b. 17 is a certain pressure data storage circuit which carries out time amount maintenance about the low-tension side pressure value PL calculated in the difference circuit 16, the differential pressure value detected with the pressure sensor 3, and a static pressure value (high-tension-side pressure PH). 18 is the degree count circuit of the pressure splash which calculates the degree of a splash of each pressure from the pressure data currently held in the store circuit 17. 19 is a correlation count circuit calculated by the approach which was able to determine the correlation of the degree of a splash of each pressure value calculated in the count circuit 18 of a pressure splash degree. 21 is a correlation record circuit where the value which shows the correlation at the time of connecting pipe plugging is

recorded. 22 is a plugging diagnostic circuit which calculates the plugging condition of connecting pipes 14a and 14b by comparing with the record value of the correlation record circuit 21 the value which shows the correlation outputted from the correlation count circuit 19. In this case, direct plugging condition is diagnosed from the correlation of the splash of a differential pressure signal, and a splash of a static pressure signal. 23 is a plugging diagnostic result signal which is got blocked and outputted from the diagnostic circuit 22. In the above configuration, a differential pressure detector 15 detects the differential pressure value and static pressure value (high-tension-side pressure PH) of the measuring object 11 which are transmitted by connecting pipes 14a and 14b. The low-tension side pressure value PL is calculated from the detected pressure value. All the data with which the differential pressure value, the static pressure value (high-tension-side pressure PH), and the low-tension side pressure value PL were measured in a certain time amount in the pressure data storage circuit 17 are held. The count circuit 18 of a pressure splash degree calculates the degree of a splash of each pressure by the data currently held in the pressure data storage circuit 17 being used for it. The correlation count circuit 7 is calculated by the approach which was able to define the correlation of the degree of a splash of each pressure outputted from the count circuit 18 of a pressure splash degree, and is outputted to the plugging diagnostic circuit 22. [the correlation in each mode (both-sides plugging of a high tension side/low-tension side single-sided plugging) of connecting pipes 14a and 14b currently held beforehand in the correlation record circuit 21], the plugging diagnostic circuits 22 are technique, such as fuzzy reasoning, diagnose a plugging condition and output it by the approach which was able to determine the diagnostic result. Furthermore, if it explains in full detail, presumption of plugging of a connecting pipe will be attained from the following correlations of a differential pressure output and a static pressure output. Usually, when orifice type hydrometry is being performed, the value of differential pressure and a static pressure always has a rocked part rather than is fixed. (Since the high-tension-side pressure is generally made into the static pressure, a high-tension-side pressure is considered to be a static pressure at this time as a static pressure also here.) The low-tension side is considered the same way as a static pressure. Therefore, if both splash width of face becomes small as compared with the splash width of face of the splash width of face and the static pressure value of the differential pressure in the condition that connecting pipe plugging of the high-tension side and low-tension side

both has not occurred, having got blocked both the high-tension side and a low-tension side connecting pipe will be presumed. Moreover, the differential pressure transmitter is usually fully separated with static pressure change in order to take out a right differential pressure output in any environments. However, when either the high-tension side or a low-tension side connecting pipe are got blocked, since a carrier beam differential pressure value is added, before and after plugging generates the effect of the pressure variation of the static pressure by plugging, in a transmitter, change which had a certain correlation in a rocked part of differential pressure and a rocked part of a static pressure appears. It is shown below. First, the case where there is no big pulsating pressure variation by a plunger pump etc. in a static pressure and differential pressure is considered to the beginning. Therefore, the splash of differential pressure or a static pressure is random pressure variation caused by the turbulent flow generated by the orifice, and the phase of a splash of both makes it there be no coincidence ******. A correlation is roughly classified according to the magnitude of the splash of differential pressure in case the high-tension side and the low-tension side are not choked up, and a splash of a static pressure. It is splash width of face when the connecting pipe is not choked up by the high-tension side and the low-tension side as for being set as the criteria object of a comparison of splash width of face below.

1) When the splash width of face of a static pressure is large compared with the splash width of face of differential pressure.

a) When both a high-tension-side connecting pipe and a low-tension side connecting pipe are got blocked.

.... The splash of differential pressure and the splash of a static pressure become small.

b) When only a high-tension-side connecting pipe is got blocked.

.... The splash width of face of a static pressure becomes small, and the splash width of face of differential pressure becomes large.

c) When only a low-tension side connecting pipe is got blocked.

.... In magnitude and a phase, the splash of differential pressure and a static pressure becomes equal. That is, the splash width of face of differential pressure becomes large, and the splash width of face of a static pressure does not change.

2) When the splash width of face of a static pressure and the splash width of face of differential pressure are the about the same.

a) When both a high-tension-side connecting pipe and a low-tension side connecting pipe are got blocked.

.... The splash of differential pressure and the splash of a static pressure become small.

b) When only a high-tension-side connecting pipe is got blocked.

.... The splash width of face of a static pressure becomes small, and the splash width of face of differential pressure does not change.

c) When only a low-tension side connecting pipe is got blocked.

.... In magnitude and a phase, the splash of differential pressure and a static pressure becomes equal. That is, there is no big change in the splash width of face of differential pressure and a static pressure.

3) When the splash width of face of differential pressure is large compared with the splash width of face of a static pressure.

a) When both a high-tension-side connecting pipe and a low-tension side connecting pipe are got blocked.

.... The splash of differential pressure and the splash of a static pressure become small.

b) When only a high-tension-side connecting pipe is got blocked.

.... The splash width of face of a static pressure becomes small, and the splash width of face of differential pressure does not change.

c) When only a low-tension side connecting pipe is got blocked.

.... In magnitude and a phase, the splash of differential pressure and a static pressure becomes equal. That is, the splash width of face of differential pressure becomes small, and the splash width of face of a static pressure does not change.

Next, the case where pulsating pressure variation is included in a static pressure or differential pressure is considered. As mentioned above, when only one side of a connecting pipe is got blocked, the pressure variation and the differential pressure value change of the direction which plugging has not generated become equal. That is, when the low-tension side is got blocked, in magnitude and a phase, the pressure variation of the high-tension side and change of differential pressure become equal. When the high-tension side is got blocked, the pressure variation of the low-tension side and the change of differential pressure of magnitude are equal, and the direction of change becomes reverse. Therefore, when having considered the case where big pulsating pressure variation was in the static pressure which a correlation [like / next] appears and can presume plugging only a high-tension-side connecting pipe is got blocked.

.... The pulsating pressure variation of a static pressure is lost and the pulsating change appears in differential pressure.

b) When only a low-tension side connecting pipe is got blocked.

.... Synchronizing with the pulsating pressure variation of a static

pressure, the same pulsating change also as differential pressure appears. That is, the pulsating pressure variation of a static pressure does not change, but the pulsating change appears in differential pressure.

As mentioned above, plugging of a connecting pipe can be presumed from the correlation of splash (pulsation) change of a static pressure and differential pressure. The result of actual hydrometry is shown in drawing 2 , and 3 and 4. b drawing of a drawing is a static pressure output with a differential pressure output. An axis of ordinate shows a pressure value, and an axis of abscissa is the data No discretized and measured, and shows a time-axis. All drawings are output change when generating connecting pipe plugging in [501-1000] false in the pressure variation in the condition that there is no connecting pipe : plugging to data No.1-500 generally. As for the measured flow rate condition, the direction of a splash of the above-mentioned static pressure of 1 corresponds, when large compared with that of differential pressure. If the high-tension side and the low-tension side generate connecting pipe plugging, as shown in drawing 2 , in a static pressure and differential pressure, splash width of face will become small. If only the high-tension side generates connecting pipe plugging, as shown in drawing 3 , the splash width of face of differential pressure will become large, and the splash of a static pressure will become small. If only the low-tension side generates connecting pipe plugging, as shown in drawing 4 , the splash of a static pressure and the splash of differential pressure will become almost equal, therefore the splash width of face of differential pressure will become large in this case. Moreover, although both correlation was divided and explained when there was nothing with the case where there is pulsation, these are intermingled actually in many cases. In such a case, plugging can be presumed by judging paying attention to the splash of a part without pulsation, or judging paying attention to pulsation. Consequently, in the need, the periodic check of the plugging condition of a **** path becomes that there is nothing, and the cutback of maintenance manday is attained. Moreover, since extent required at the time of the need and a plugging diagnosis are attained, the dependability of a pressure survey improves. Moreover, although years of experience was required to guess the plugging condition of a connecting pipe, the diagnosis of anyone is attained from the abnormality output of a pressure survey machine by using this invention equipment. Drawing 5 is the important section configuration explanatory view of other examples of this

invention. In this example, 31 is a plugging diagnostic circuit which calculates the plugging condition of connecting pipes 14a and 14b by comparing with the record value of the correlation record circuit 21 the value which shows the correlation outputted from the correlation count circuit 19. In this case, the plugging condition of one side of a connecting pipe or both is detected from the correlation of the splash width of face of the low-tension side pressure value which deducts a differential pressure value and is acquired from the splash width of face of a differential pressure signal, the splash width of face of the static pressure signal acquired from a high-tension-side pressure value, and a static pressure value, and a detection signal is emitted. Consequently, connecting pipe plugging of the low-tension side which was not clear can be clarified in the drawing 1 example by taking the difference of a static pressure value and a differential pressure value. That is, it is the static pressure-differential pressure which is said "The splash of differential pressure and a static pressure becomes equal in magnitude and a phase". Or it can express because the absolute value of the value of a differential pressure-static pressure becomes small. By this, when presuming, a diagnosis becomes possible simpler more certainly. It is drawing 2 and as a result of [of 3 and 4] measurement, and the result of having calculated static pressure-differential pressure (plugging low-tension side pressure) is actually shown in drawing 6 (a), (b), and (c). (a), (b), and (c) are calculated from drawing 2 , and the static pressure value and differential pressure value of 3 and 4, respectively. If low-tension side connecting pipe plugging occurs, splash width of face becomes small like drawing 6 (c), and it can presume that plugging occurred. Drawing 7 is the important section configuration explanatory view of other examples of this invention. In this example, 41 is a plugging diagnostic circuit which calculates the plugging condition of connecting pipes 14a and 14b by comparing with the record value of the correlation record circuit 21 the value which shows the correlation outputted from the correlation count circuit 19. In this case, the plugging condition of one side of a connecting pipe or both is detected from the value which deducted the degree of a splash of a low-tension side pressure value from the degree of a splash of a high-tension-side pressure value, the value which deducted the degree of a splash of differential pressure from the degree of a splash of a high-tension-side pressure value, and the value which deducted the degree of a splash of differential pressure from the degree of a splash of a low-tension side pressure value, and a detection signal is emitted. Consequently, when presuming plugging of a connecting pipe actually and it merely

presumes only by change of splash width of face, in spite of the splash width of face of differential pressure and a static pressure changes and not choking it up according to the measured flow rate conditions, there is a possibility of presuming plugging. Moreover, in order to avoid this, various conditions must be attached to a correlation and presumption of plugging becomes complicated. Then, it can presume simpler by performing the following signal processing.

1) Calculate the splash width of face Dpb, Spb, and PLb of a differential pressure output, a static pressure (high-tension-side pressure) output, and a static pressure-differential pressure (low-tension side pressure) output, and take each difference. For example, change of the splash width of face by flow rate change is cancellable by using the parameters Q, R, and S calculated by Q=Spb-PLb, R=PLb-Dpb, and S=Spb-Dpb.

a) When the high-tension side and the low-tension side get a connecting pipe blocked.
Since Dpb, Spb, and all PLb(s) become small, all of Q, R, and S become small.

b) When the connecting pipe of the high-tension side is got blocked.
Since Spb becomes small, Q becomes a negative value, and since Dpb also takes a certain amount of value by the pressure variation of the low-tension side, S also becomes a negative value. If PLb is compared with Dpb, since Dpb will be generated from the pressure splash of the low-tension side, R takes the value near zero.

c) When the connecting pipe of the low-tension side is got blocked.
Since PLB becomes small, Q increases, and since Dpb also takes a certain amount of value by the pressure variation of the high-tension side, as for R, a negative value is taken. Since Dpb will be generated from the pressure splash of the high-tension side if Spb is compared with Dpb, S takes the value near zero.

A actual measurement result is shown in drawing 8 , and 9 and 10. The rate of flow became slow in drawing 8 and the order of 9 and 10, and the static pressure became high and has changed flow rate conditions. The view of the graph shown in drawing is the same as drawing 1 . (a) shown in drawing, (b), and (c) correspond with (a) of drawing 6 , (b), and (c). Moreover, although drawing 8 , 9 or 10 (R) of (b), drawing 8 , and 9 or 10 (S) of (c) have taken not zero but the forward value strictly As for the case of drawing 8 and 9 or 10 (b), the pressure variation of the low-tension side is considered propagation and because the splash of differential pressure became smaller than the splash of a low-tension

side pressure a little by the center diaphragm structure of the transmitter which used this for the experiment through a center diaphragm also at the high-tension side. In drawing 8 and (c) of 9 and 10, it can explain similarly. Drawing 11 is the important section configuration explanatory view of other examples of this invention. In this example, 51 is a plugging diagnostic circuit which calculates the plugging condition of connecting pipes 14a and 14b by comparing with the record value of the correlation record circuit 21 the value which shows the correlation outputted from the correlation count circuit 19. In this case, each difference of the pressure value of a certain time of day of the low-tension side pressure value which lengthened differential pressure and was acquired from differential pressure, the static pressure, and the static pressure, and the pressure value in front of one is searched for, the optimal combination is taken out from the combination of that product reciprocal-differences sum by making the value of these three differences into a parameter, the plugging condition of one side of the optimal connecting pipe or both is detected, and a detection signal is emitted. Consequently, the plugging condition of one side of the optimal connecting pipe or both is detectable. Specifically it is discretized, the measured differential pressure and the static pressure value are used, and it is a. A low-tension side pressure value is first calculated by lengthening differential pressure from a static pressure.

b. Take difference with the pressure value in front of one. for example, -- if the pressure value of a certain time of day sets the pressure value in front of one to DPn-1, SPn-1, and Pn-1 from it as DPn, SPn, and PLn -- difference -- dDPn=DPn-DPn -1 dSPn=SPn-SPn -1 dPLn=PLn-PLn -1 It calculates.

c. Using Parameters dDPn, dSPn, and dPLn, search for the correlation of DP, SP, and PL and presume a plugging condition.

In presuming a plugging condition, the following properties are used here using this parameter.

a) The splash of a pressure becomes small when plugging generates the H side and the L side connecting pipe. (The absolute value of dDPn, dSPn, and dPLn becomes small)

b) When getting the L side connecting pipe blocked, the splash of a differential pressure output and a static pressure output is in agreement (dDPn**dSPn and |dDPn|**|dSPn|),
The splash of a low-tension side pressure becomes small. (The absolute value of dPLn becomes small)

c) When getting the H side connecting pipe blocked, the splash of a differential pressure output and a low-tension side output has a reverse

sign and it corresponds. (dDPn**-dPLn and |dDPn|**|dPLn|)
The splash of a static pressure becomes small. (The absolute value of dSPn becomes small)

1. By having hung each, each parameter has the following semantics.
dDPnxdSPn: If it is in the inclination to take a forward sign, it will be shown that the sign of dDPn and dSPn is in agreement, and it will be guessed that **** of the L side connecting pipe occurred from b. Moreover, if an absolute value becomes small, since it is shown that the splash of either DP from a or SP is small, it is guessed that it is choked up both the H side / L sides, or the H side is choked up.
dDPnxdPLn: If it is in the inclination to take a negative sign, it will be shown that the sign of dDPn and dPLn is reverse and it will be guessed that **** of the H side connecting pipe occurred from c. Moreover, if an absolute value becomes small, since it is shown that the splash of either DP from a or PL is small, it is guessed that it is choked up both the H side / L sides, or the L side is choked up.
dSPnxdPLn: If an absolute value becomes small, since it is shown that the splash of either DP from a or PL is small, it is guessed that it is choked up both the H side / L sides, or the H or L side is choked up.

2. By breaking each, each parameter has the following semantics.
dSPn/dDPn: If a forward sign is taken and an absolute value is in the inclination to approach 1, the magnitude of dSPn and dDPn will be equal, it will be shown that a sign is also equal and it will be guessed that **** of the L side connecting pipe occurred from b. If an absolute value becomes small, it will be shown that dSPn became small and it will be guessed that plugging occurred in the H side connecting pipe from a.
dDPn/dSPn: A forward sign is taken, it is shown that the magnitude of dDPn and dSPn is equal and a sign's is equal if an absolute value is in the inclination to approach 1, and it is guessed that **** of the L side connecting pipe occurred from b. If an absolute value becomes large, it will be shown that dSPn became small and it will be guessed that plugging occurred in the H side connecting pipe from a.
dPLn/dDPn: A negative sign is taken, if an absolute value is in the inclination to approach 1, the magnitude of dPLn and dDPn is equal, it is shown that the sign is reverse, and it is guessed that **** of the H side connecting pipe occurred from c. If an absolute value becomes small, it will be shown that the magnitude of dPLn became small and it will be guessed that plugging occurred in the L side connecting pipe from a.

dDPn/dPLn: A negative sign is taken, if an absolute value is in the inclination to approach 1, the magnitude of dPLn and dDPn is equal, it is shown that the sign is reverse, and it is guessed that **** of the H side connecting pipe occurred from c. If an absolute value becomes large, it will be shown that the magnitude of dPLn became small and it will be guessed that plugging occurred in the L side connecting pipe from a.
dSPn/dPLn: If an absolute value becomes large, it will be shown that dPLn became small and it will be guessed that plugging occurred in the L side connecting pipe from a. If an absolute value becomes small, it will be shown that dSPn became small and it will be guessed that plugging occurred in the H side connecting pipe from a.
dPLn/dSPn: If an absolute value becomes large, it will be shown that dSPn became small and it will be guessed that plugging occurred in the H side connecting pipe from a. If an absolute value becomes small, it will be shown that dPLn became small and it will be guessed that plugging occurred in the L side connecting pipe from a.

3. Each parameter has the following semantics more for adding each.
dDPn+dSPn: If an absolute value increases, the inclination whose sign of dDPn and dSPn corresponds will be shown and it will be guessed that **** of the L side connecting pipe occurred from b.
dDPn+dPLn: If an absolute value decreases, the inclination it is reverse and corresponds will be shown, and it will be guessed that **** of the H side connecting pipe occurred from c. [of the sign of dDPn and dPLn]

4. By lengthening each, each parameter has the following semantics.
dDPn-dSPn: If an absolute value decreases, the inclination for the magnitude of dDPn and dSPn to be equal and for a sign to be equal will be shown, and it will be guessed that **** of the L side connecting pipe occurred from b. Moreover, if an absolute value increases, since it is shown that SP's splash is small, it is guessed that the H side is choked up from a.
dSPn-dDPn: If an absolute value decreases, the inclination for the magnitude of dDPn and dSPn to be equal and for a sign to be equal will be shown, and it will be guessed that **** of the L side connecting pipe occurred from b. Moreover, since it is shown that SP's splash is small similarly, it is guessed that the H side is choked up from a.
dDPn-dPLn: If an absolute value increases, the inclination for the sign of dDPn and dPLn to be reverse will be shown, and it will be guessed that **** of the H side connecting pipe occurred from c. Moreover, if an absolute value decreases, since it is shown that the splash of PL is

small, it is guessed that the L side is choked up from a.
dPLn-dDPn: If an absolute value increases, the inclination for the sign of dDPn and dPLn to be reverse will be shown, and it will be guessed that **** of the H side connecting pipe occurred from c. Moreover, since it is shown that the splash of PL is small similarly, it is guessed that the L side is choked up from a.
A plugging diagnosis of the optimal connecting pipe can be performed combining the parameter to 1-4 shown above. For example, if three parameters, dDPnxdSPn, dDPnxdPLn, and dSPnxdPLn, are used (1) -- dDPnxdSPn > 0 And |dSPnxdPLn| |dDPnxdPLn| reduction --- **** of the >L side connecting pipe -- generating (2) dDPnxdPLn < 0 And |dDPnxdSPn| |dSPnxdPLn| Reduction --- Generating (3) dDPnxdSPn, dDPnxdPLn, and all dSPnxdPLn decrease [**** of the >H side connecting pipe]. --- It is got blocked like ****'s generating of the >H side / L side connecting pipe, and condition can be presumed.
[0010]
[Effect of the Invention] This invention is duct lock-out detection equipment characterized by to provide the detection means which detects the plugging condition of one side of said connecting pipe, or both in the duct lock-out detection equipment possessing a differential-pressure detection means detect differential pressure and a static pressure through [as explained above] (1) 2 a connecting pipe and this connecting pipe, from the correlation of the splash of said differential-pressure signal, and a splash of said static pressure signal, and emits a detection signal.
(2) Add a differential pressure value from the splash width of face of a static pressure value and the static pressure value at the time of making into a static pressure the splash width of face of the low-tension side pressure value which deducts a differential pressure value and is acquired from the splash width of face of a static pressure value and the static pressure value at the time of making the splash width of face of a differential pressure value, and a high-tension-side pressure value into a static pressure or the splash width of face of a differential pressure value, and a low-tension side pressure value. Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the correlation of the splash width of face of the high-tension-side pressure value acquired, and emits a detection signal.
(3) Duct lock out detection equipment of claim 1 characterized by providing the detection means which detects the plugging condition of one side of a connecting pipe, or both from the difference of the degree

one side of a connecting pipe, or both from the difference of the degree of a splash of a high-tension-side pressure value, and the degree of a splash of a low-tension side pressure value, the degree of a splash of a high-tension-side pressure value and the difference of the degree of a splash of differential pressure, and the difference of the degree of a splash of a low-tension side pressure value, and the degree of a splash of differential pressure, and emits a detection signal. It constituted.
Consequently, according to claim 1 of a claim, in the need; the periodic check of the plugging condition of a **** path becomes that there is nothing, and the cutback of maintenance manday is attained. Moreover, since extent required at the time of the need and a plugging diagnosis are attained, the dependability of a pressure survey improves.
Moreover, although years of experience was required to guess the plugging condition of a connecting pipe, the diagnosis of anyone is attained from the abnormality output of a pressure survey machine by using this invention equipment. According to claim 2 of a claim, connecting pipe plugging of the low-tension side which was not clear can be clarified in claim 1 by taking the difference of a static pressure value and a differential pressure value. By this, when presuming, a diagnosis becomes possible simpler more certainly. When according to claim 3 of a claim presuming plugging of a connecting pipe actually and it merely presumes only by change of splash width of face, in spite of the splash width of face of differential pressure and a static pressure changes and not choking it up according to the measured flow rate conditions, there is a possibility of presuming plugging. Moreover, in order to avoid this, various conditions must be attached to a correlation and presumption of plugging becomes complicated. By signal processing of invention of this claim 3, it can presume simpler.
Therefore, according to this invention, detection of plugging of a connecting pipe can be possible, the dependability of a pressure survey can be improved, and a maintenance can realize easy duct lock out detection equipment.

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⑭発明の名称　シール装置付複列玉軸受

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明細書

1. 発明の名称　シール装置付複列玉軸受

2. 特許請求の範囲

(1)内周面に複数の内方軌道を有する外輪相当部材と、外周面に複数の外方軌道を有する内輪相当部材と、上記複数の内方軌道と複数の外方軌道との間に設けられた複数の玉と、この複数の玉を保持する為、それぞれ環状に形成された複数の保持器とから成る複列玉軸受であって、上記複数の保持器の内の少なくとも一方の保持器の外端部にシール板を、当該保持器と一体に設けると共に、このシール板の外周縁を上記転がり軸受を構成する外輪相当部材の内周面に、内周縁を上記転がり軸受を構成する内輪相当部材の外周面に、それぞれ近接させて、上記外輪相当部材の内周面と内輪相当部材の外周面との間の空間の一端開口部を塞いだ事を特徴とするシール装置付複列玉軸受。

(2)外輪相当部材が一体で、内輪相当部材である内輪が二分割されている、請求項1に記載のシール装置付複列玉軸受。

(3)内輪相当部材が一体で、外輪相当部材である外輪が二分割されている、請求項1に記載のシール装置付複列玉軸受。

(4)外輪相当部材と内輪相当部材との何れもが一体である、請求項1に記載のシール装置付複列玉軸受。

(5)シール板の内周縁部分と内輪相当部材の外周部分との係合により、このシール板が内輪相当部材に案内されており、シール板の外周縁部分と外輪相当部材の内周部分との間に、ラビリンスシール部が形成されており、このラビリンスシール部の隙間寸法は、上記係合部分の隙間寸法よりも大きくしている、請求項1～5の何れかに記載のシール装置付複列玉軸受。

3. 発明の詳細な説明

（産業上の利用分野）

この発明に係るシール装置付複列玉軸受は、例えばコンピュータの外部記憶装置として使用されるハードディスクを回転駆動する為の、電動モータに組み込んで利用される。

（従来の技術）

ハードディスクを回転駆動する為の装置（HDD）には、従来から、例えば第12図に示す様なスピンドルモータが組み込まれている。

この第12図に示したスピンドルモータは、外周面に形成した取付フランジ1により、取付基板等に固定されるハウジング2の内側に回転軸3を、玉軸受4、4を介して回転自在に支承すると共に、この回転軸3の端部に、ロータとして機能するハブ6を固定し、このハブ6に、ハードディスクを固定する様にしている。

ハウジング2の内側に回転軸3を支承する為の玉軸受4、4は、それぞれ第13図に詳示する様に構成されている。

7は内周面に内方軌道8を形成した外輪、9は外周面に外方軌道10を形成した内輪、11は上記内方軌道8と外方軌道10との間に複数設けられた玉、12はこれら複数の玉11を回転自在に保持する為の保持器、13、13は、それぞれの外周縁を外輪7の両端部内周面に支持し、それぞれの内周縁を内輪9の両端部外周面に近接させたシール板である。

上述の様に構成される玉軸受4を、第12図に示した様な、ハードディスク駆動用のスピンドルモータに組み込む場合、外輪7をハウジング2に内嵌固定し、内輪9を回転軸3に外嵌固定する。この結果回転軸3が、ハウジング2の内側に回転自在に支承される。

又、外輪7の両端部内周面に支持したシール板13、13は、両シール板13、13に挟まれた部分に存在し、前記複数の玉11が転動する部分を潤滑するグリースが外部に漏洩したり、或は上記部分に異物が進入する事を防止する。

（発明が解決しようとする課題）

ところが、上述の様に構成される玉軸受4、4を組み込んだ、従来のハードディスク駆動用電動モータの場合、玉軸受4、4の構造に起因して、次に述べる様な不都合を生じる。

即ち、グリースが外部に漏洩するのを防止する為のシール板13、13の内、一方（第13図の上方）のシール板13は、保持器12との干渉を防止する為、この保持器12によって保持された複数の玉11から大きく離れた位置に設ける必要がある。

この為、玉軸受4、4の幅寸法W（第13図）が大きくなる事が避けられず、この様な玉軸受4、4を組み込んだスピンドルモータの厚さ寸法T（第12図）も大きくなる事が避けられない。

HDD等の設置スペースは、近年に於けるラップトップ型のOA機器の普及等により、極めて狭くなっており、上述の様な原因により、スピンドルモータの厚さ寸法Tが僅かでも大きくなる事は好ましくない。

第12図に示した様な単列の玉軸受4、4を2個組み合わせて使用するのに代えて、外輪の内周面と内輪の外周面とに、それぞれ複数の内方軌道或は外方軌道を有する、複列の玉軸受を使用すれば、或る程度モータの厚さ寸法を小さくする事が出来るが、使用条件によっては未だ不十分な場合も考えられる。

本発明のシール装置付複列玉軸受は、上述の様な事情に鑑みて考えられたものである。

（課題を解決する為の手段）

本発明のシール装置付複列玉軸受は、従来から知られている複列玉軸受と同様に、内周面に複数の内方軌道を有する外輪相当部材と、外周面に複数の外方軌道を有する内輪相当部材と、上記複数の内方軌道と複数の外方軌道との間に設けられた複数の玉と、この複数の玉を保持する為、それぞれ環状に形成された複数の保持器とから構成されている。

更に、本発明のシール装置付複列玉軸受に於いては、上記複数の保持器の内の少なくとも一方の保持器の外端部にシール板を、当該保持器と一体に設けると共に、このシール板の外周縁を上記転がり軸受を構成する外輪相当部材の内周面に、内周縁を上記転がり軸受を構成する内輪相当部材の外周面に、それぞれ近接させて、上記外輪相当部材の内周面と内輪相当部材の外周面との間の空間

の一端開口部を塞いでいる。

（作　用）

上述の様に構成される本発明のシール装置付複列玉軸受は、幅寸法を十分に小さく出来る為、この複列玉軸受を電動モータに組み込んだ場合、この電動モータの厚さ寸法を十分に小さくする事が可能となる。

（実施例）

次に、図示の実施例を説明しつつ、本発明を更に詳しく説明する。

第1図は本発明のシール装置付複列玉軸受の第一実施例を示す断面図である。

14は外輪で、この外輪14の内周面には、2本の内方軌道15、15を形成している。又、16は内輪で、この内輪16は、それぞれの外周面に外方軌道17、17を形成した、2個の内輪素子18、18を組み合わせる事で構成されている。

上記複数の内方軌道15、15と複数の外方軌道17、17との間には、それぞれ複数の玉19、19を設けており、この複数の玉19、19を、それぞれ環状に形成された複数の保持器20、20により保持している。

更に、上記複数の保持器20、20の外端部にはそれぞれシール板21、21を、各保持器20、20と一体に設けると共に、各シール板21、21の外周縁を上記外輪14の両端部内周面に、内周縁を内輪16の両端部外周面に、それぞれ近接させて、上記外輪14の内周面と内輪16の外周面との間の空間22の両端開口部を塞いでいる。

即ち、第2図に詳示する様に、各シール板21の内周縁部分23と、内輪16の両端部外周部分で、表面を平滑に仕上げられた部分とを、極く小さい（例えば50μm程度）隙間を介して対向させる事により、各シール板21が内輪16に摺動案内される様にすると共に、各シール板21の外周縁部分24と外輪14の両端部内周部分との間に、屈曲した隙間を形成する事で、上記摺動案内用の隙間よりも大きな（例えば150μm程度）の隙間寸法を有する、ラビリンスシール部25としている。各シール板21と上記内周縁部分23及び外周縁部分24との関係を、上述の様に構成する結果、各シール板21、21の存在によるトルク損失を少なくして、しかも上記ラビリンスシール部25の隙間寸法精度が安定し、各シール板21によるシール性が良好になる。

上述の様に構成される本発明のシール装置付複列玉軸受は、幅寸法w（第1図）を十分に小さく出来る為、この複列玉軸受を電動モータに組み込んだ場合、この電動モータの厚さ寸法を十分に小さくする事が可能となる。

又、第1図に示したシール装置付複列玉軸受の場合、玉19、19を設けた空間22の両端開口部が、シール板21、21により塞がれている為、電動モータへの組み付け後に、この空間22内に存在するグリースが外部に洩れ出す事を防止出来るだけでなく、組み付け前に、上記空間22内に塵芥等の異物が進入する事を防止する事が出来る。

尚、上記第一実施例のシール装置付複列玉軸受の場合、電動モータ等への組み込み時に、内輪素子18、18を軸方向（第1図の上下方向）に押圧する事で、各内輪素子18、18と外輪14との間に設けた玉19、19に予圧を付与する。この際、一方の内輪素子18を先に回転軸3の外周面に接着しておき、他方の内輪素子18は、予圧付与後に、回転軸3の外周面に接着する。

次に、第3図は本発明のシール装置付複列玉軸受の第二実施例を示している。

本実施例の場合、上記第一実施例の場合とは逆に、内輪16を一体とし、外輪14を2個の外輪素子26、26から構成している。

この為、本実施例のシール装置付複列玉軸受の場合、電動モータ等への組み込み時に、外輪素子26、26を軸方向（第3図の上下方向）に押圧する事で、各外輪素子26、26と内輪16との間に設けた玉19、19に予圧を付与する。

次に、第4図は本発明のシール装置付複列玉軸受の第三実施例を示している。

本実施例の場合、外輪１４と内輪１６とを、何れも一体に形成している。

従って本実施例のシール装置付複列玉軸受の場合、玉軸受の組み立て時に、外輪１４と内輪１６との間に設ける玉１９、１９に予圧を付与しておく。

上述の様に構成される、本発明のシール装置付複列玉軸受は、例えば第５～１１図に示す様に、ハードディスク駆動用等に使用されるモータに組み込まれる。

先ず、第５図は、本発明のシール装置付複列玉軸受を、ボトムロータ型のスピンドルモータに組み込んだ例を示している。この第５図に示したスピンドルモータは、外周面に形成した取付フランジ１により、取付基板等に固定されるハウジング２の内側に回転軸３を、玉軸受を介して回転自在に支承すると共に、この回転軸３の一端部にロータ５を固定する事で構成され、上記回転軸３の他端部に固定したハブ６に、ハードディスクを固定する様にしている。

ハウジング２の内側に回転軸３を支承する為の玉軸受は、前述の第４図に示す様に、内周面に２本の内方軌道１５、１５を形成した外輪１４と、外周面に２本の外方軌道１７、１７を形成した内輪１６との間に、保持器２０、２０によって保持された複数の玉１９、１９を設ける事で構成されており、上記各保持器２０、２０の外端部には、それぞれシール板２１、２１を形成している。

この為、シール装置付複列玉軸受を構成する玉１９、１９部分に、外部から塵芥が進入したり、或は上記部分に存在するグリースが、ハードディスクを設置した清浄空間内に進入する事を防止する機能を確保しつつ、この玉軸受を組み込んだスピンドルモータの厚さ寸法ｔを小さくする事が出来る。

更に、第５図に示したスピンドルモータに於いては、前記回転軸３の外周面とハウジング２の内周面との間で、シール装置付複列玉軸受と、ハードディスクを固定する為のハブ６との間部分に、円輪状に形成されたポールピース２７と磁性流体２８とから成る磁性流体シール装置２９を、前記シール板２１に対向させた状態で設けて、玉１９を設けた部分に存在するグリースが、ハードディスクを設けた清浄空間内に進入する事を、より確実に防止している。

尚、本発明のシール装置付複列玉軸受を組み込む為の電動モータは、第５図に示す様なボトムロータ型のスピンドルモータに限らず、他の形式の電動モータに適用して、その電動モータの厚さ寸法を小さくする事が出来る。

例えば、第６図に示す様な、内輪回転型のインハブ型スピンドルモータに本発明のシール装置付複列玉軸受を組み込んだり、第７図に示す様な、外輪回転型のインハブ型スピンドルモータに本発明のシール装置付複列玉軸受を組み込んだりする事も出来る。

又、スピンドルモータに組み込むシール装置付複列玉軸受としては、前記第４図に示した外輪１４と内輪１６との何れもが一体のものに限らず、例えば第１図に示す様な、内輪１６が二分割されたシール装置付複列玉軸受を用いて、第８図に示す様なスピンドルモータ、更には他の形式の電動モータを構成したり、或は、第３図に示す様な、外輪１４が二分割されたシール装置付複列玉軸受を用いて、第９図に示す様なスピンドルモータ、或は他の形式の電動モータを構成する事も出来る。

但し、外輪１４が一体型のシール装置付複列玉軸受を使用した場合、電動モータ用のコイル３０を直接外輪１４の外周面に固定すると言った、出願人会社の従業者である『井通隆正』（神奈川県川崎市中原区中丸子１１６５）の発明と組み合わせる事により、第１０図に示す様に、厚さ寸法ｔだけでなく、外径寸法ｄも小さな電動モータを得る事が出来る。

更に、第１１図に示す様に、外輪１４の外側に固定したコイル３０の一部を、この外輪１４の一端面から突出させると共に、ハードディスクを固定する為のハブ６の一部に、上記外輪１４の突出部３１が進入自在な凹溝３２を形成する事によ

り、上記コイル30とハブ6との間にラビリンスシール部を構成すれば、磁性流体シール装置を省略しても、玉11、11部分に存在するグリースが、ハードディスクを設けた清浄空間に進入する事を確実に防止出来る。

尚、ラビリンスシール部を設ける部分は、上記コイル30とハブ6との間に代えて、或はコイル30とハブ6との間と共に、取付フランジ1とハブ6との間に形成する事も出来る。即ち、取付フランジ1の内側面（第11図の上面）とハブ6の開口縁部との一方に環状の凹溝を、必要に応じて他方に、この凹溝に進入自在な突条を、それぞれ形成すれば、取付フランジ1とハブ6との間にラビリンスシール部を設けて、玉11、11部分に存在するグリースが、ハードディスクを設けた清浄空間に進入する事を確実に防止出来る。

又、第11図に於いては、内輪16を回転軸3と一体にしているが、内輪16と回転軸3とは一体である必要はない。但し、内輪16を回転軸3と一体にした複列玉軸受が、本発明の技術的範囲に属する事は、勿論である。同様に、外輪14に就いても、ハウジング等と一体に形成されたものが、本発明の技術的範囲に属する事は勿論である。即ち、これらの一体構造の場合、回転軸或はハウジングが、内輪相当部材或は外輪相当部材となる。

（発明の効果）

本発明のシール装置付複列玉軸受は、以上に述べた通り構成され作用する為、電動モータに組み込んだ場合に、この電動モータの厚さ寸法を小さくして、電動モータを組み込んだ各種機器の小型化を図る事が出来る。

4. 図面の簡単な説明

第1図は本発明の第一実施例を示す断面図、第2図は第1図のA部拡大図、第3～4図は本発明の第二～第三実施例を示す、それぞれ断面図、第5～11図は、本発明のシール装置付複列玉軸受を電動モータに組み込んだ状態の7例を示す、それぞれ断面図、第12図は従来の電動モータの1例を示す断面図、第13図は第12図のB部に相当する拡大図である。

1：取付フランジ、2：ハウジング、3：回転軸、4：玉軸受、5：ロータ、6：ハブ、7：外輪、8：内方軌道、9：内輪、10：外方軌道、11：玉、12：保持器、13：シール板、14：外輪、15：内方軌道、16：内輪、17：外方軌道、18：内輪素子、19：玉、20：保持器、21：シール板、22：空間、23：内周縁部分、24：外周縁部分、25：ラビリンスシール部、26：外輪素子、27：ポールピース、28：磁性流体、29：磁性流体シール装置、30：コイル、31：突出部、32：凹溝。

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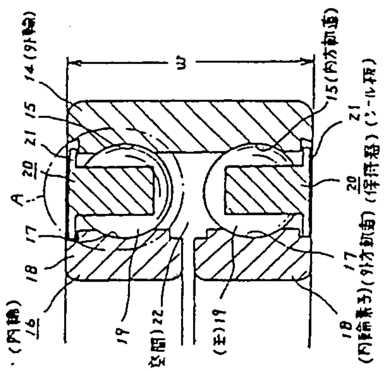
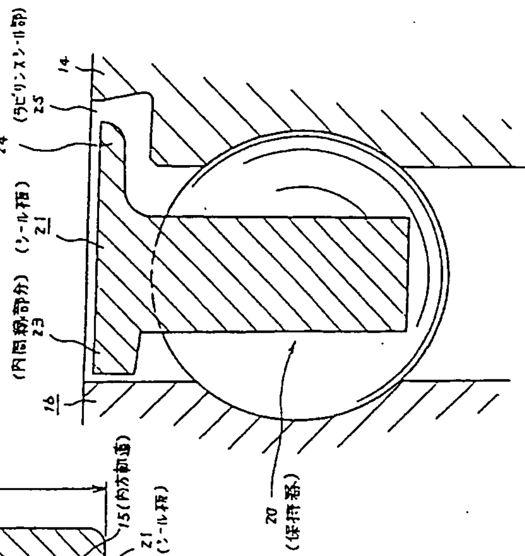
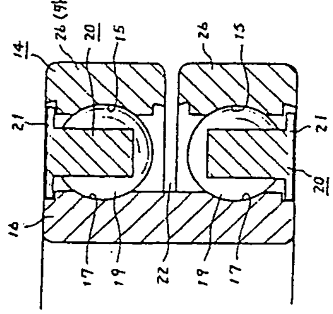
第1図



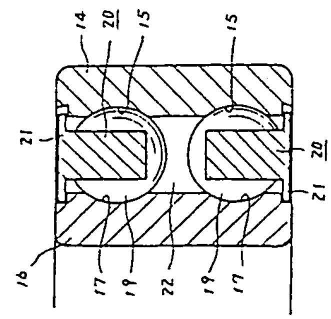
第2図



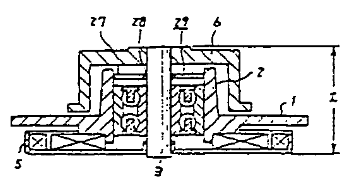
第3図



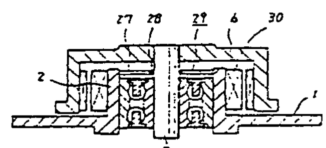
第4図



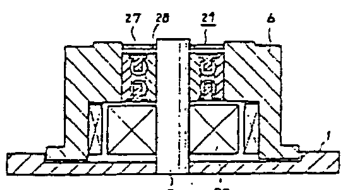
第5図



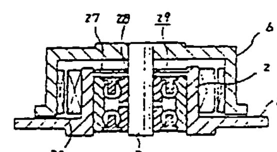
第6図



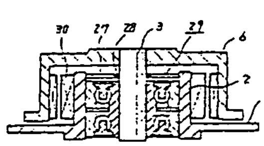
第7図



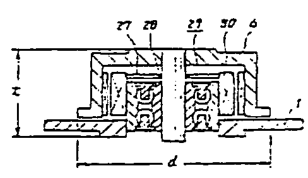
第8図



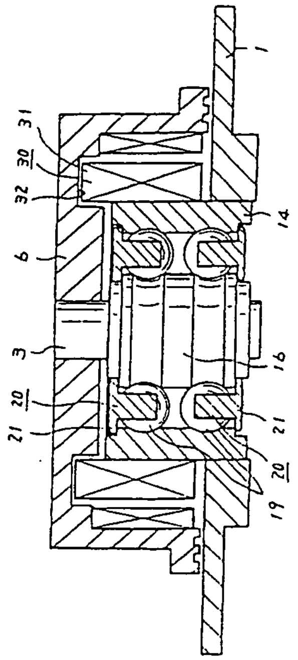
第9図



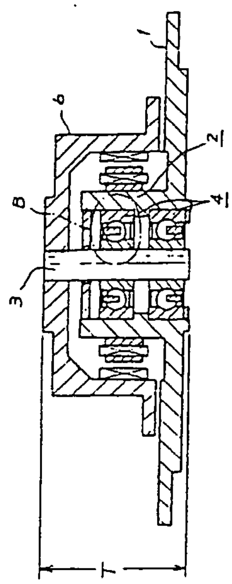
第10図



第11図



第12図



第13図